DOCUMENT RESUME

ED 054 495	24	CG 006 628
AUTHOR	McCall, John N.	
TITLE	The Relation of Family Size, Birth Order, and Socio-economic Status to the Abilities of High School Students. Final Report.	
INSTITUTION	Southern Illinois Univ., Edwardsville.	
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Research.	
BUREAU NO	BR-O-E-022	
PUB DATE	Mar 71	
GRANT	OEG-5-70-0016-512	
NOTE	27p.	
EDRS PRICE	MF-$0.65 HC-$3.29	
DESCRIPTORS	*Birth Order; Demography; *Family (Sociological Unit); High School Students; *Individual Differences; *Intelligence Differences; Sex Differences; Sociocultural Patterns; *Socioeconomic Influences	

ABSTRACT

Individual differences in general intelligence and in 8 different special aptitudes or skills were hypothesized to be independent of family size and birth order indices. Evidence to the contrary, in the form of linear correlations, was predicted to be due to the confounding influence of socio-economic factors. Among the more familiar demographic indices, only sex was expected to be a source of variation in special aptitude--over and above general intelligence. Data for testing these hypotheses were obtained from the "Project Talent Data Bank." The hypotheses were generally supported. Intelligence and special ability were found to be independent of family size and birth order indices when socio-economic differences in intelligence were removed. No differences in special ability were associated with socio-economic status after differences due to general intelligence were removed. These findings discount the need for special educational programs which might be planned for later born children on the assumption that they are intellectually handicapped. The sex differences in ability may justify existing differences in vocational programs for boys and girls. But the actual reasons for these differences require further study. (Author)

ED054495

FINAL REPORT

Project No. 0-E-022
Grant No. OEG-5-70-0016 (512)

THE RELATION OF FAMILY SIZE, BIRTH ORDER, AND SOCIO-ECONOMIC STATUS TO THE ABILITIES OF HIGH SCHOOL STUDENTS

JOHN N. McCALL

Southern Illinois University at Edwardsville
Edwardsville, Illinois 62025

March 1971

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

.006 628

Final Report

Project No. 0-E-022

Grant No. OEG-5-70-0016 (512)

The Relation of Family Size, Birth Order, and Socio-economic Status to the Abilities of High School Students

John N. McCall

Southern Illinois University-Edwardsville

Edwardsville, Illinois 62025

March 1971

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF

HEALTH, EDUCATION, AND WELFARE

Office of Education

Bureau of Research

CONTENTS

CONTENTS
(cont.)

Summary

Individual differences in general intelligence and in eight different special aptitudes or skills were hypothesized to be independent of family size and birth order indices. Evidence to the contrary, in the form of linear correlations, was predicted to be due to the confounding influence of socio-economic factors. Among the more familiar demographic indices, only sex (not family size, birth order, nor socio-economic status) was expected to be a source of variation in special aptitude--over and above general intelligence. For example, males were predicted to perform better than females on tests for mechanical comprehension and spatial judgment. Females were expected to perform better on English language skill tests and tests for perceptual judgment.

Data for testing these hypotheses were obtained from the Project Talent Data Bank. This source contains the results from a two-day battery of tests and questionnaires given in 1960 to nearly 400,000 high school students. A 1% subsample of this representative national sample was drawn for the present study. Besides the IQ-composite scores, eight different special ability scores were obtained for each student. These scores were chosen to provide a wide range of the talents considered in educational and vocational evaluations.

The hypotheses were generally supported. Intelligence and special ability were found to be independent of family size and birth order indices when socio-economic differences in intelligence were removed. No differences in special ability were associated with socio-economic status after differences due to general intelligence were removed. But there were sex differences over and above general intelligence. Specifically, males excelled in mechanical comprehension and females excelled males in English language skills.

These findings discount the need for special educational programs which might be planned for later born children on the assumption that they are intellectually handicapped. Birth control policies must also be justified on other grounds than the theory of intellectual primogeniture. Social class differences in ability appear to be mostly limited to verbal or language skills, which are principle components of developed intelligence. The sex differences in ability may justify existing differences in vocational educational programs for boys and girls. But the actual reasons for these differences requires further study.

Introduction

It is widely believed that first borns and only children are especially favored for intellectual growth. Oftentimes, this theory

of primogeniture includes the belief that first and later borns differ also in the kinds of skill they develop. First borns, for example, are assumed to excel their siblings in verbal and reasoning skills; while later borns are expected to develop better perceptual and motor skills.

Primogeniture theories differ from conventional biological and social theories of intelligence by giving more weight to ordinal relationships within the family. Not only is the individual's intelligence affected by chance genetic factors and by the cultural opportunities provided him and all his siblings, his intelligence is influenced by the unique position which he holds within the family constellation.

Birth order effects upon intelligence, if any, could derive from genetic or cultural causes. For example, the "uterine fatigue" hypothesis seeks to explain defects in terms of uterine conditions and related genetic materials which supposedly deteriorate with the increasing age or fertility of mothers. Some support for this view is found in mongolism, which occurs far more often with middle age mothers who have already had children. Perhaps more popular is the assumption that first borns and only children get more parental attention and thereby develop better verbal skills, including intelligence.

If these primogeniture theories are valid, responsible parents and public officials are obliged to consider birth control measures and special education programs which would compensate children handicapped by their birth status. But definitive evidence on this problem seems to be lacking. Even the more feasible correlation studies are suspect because of the general failure to control for spurious socio-cultural effects. Specifically, there remains the underlying suspicion that the higher ability scores found for first borns and only children are due simply to the fact that such children are more likely to come from families which are smaller and which enjoy a higher socio-economic status.

The present study was planned to show that intellectual primogeniture is not supported when definite controls are imposed for differences in socio-economic status. A recent study by the investigator (McCall and Johnson, in press) demonstrated this point in the case of children from several southwest Illinois schools. This new study, in part, replicates these findings for a representative, national sample of high school students. This study also goes beyond the study of differences in general intelligence by investigating the relationship of family size, birth order, and socio-economic status to several different, narrowly defined aptitudes and skills.

Hypotheses

The main hypothesis, that intellectual primogeniture is not supported where socio-cultural factors are controlled, takes into

account general intelligence as well as several different special aptitudes, or skills. The possibility that family size, or birth order, interact with sex or socio-economic status is also ruled out. For instance, intelligence is not expected to correlate with family size differently for males than for females. Nor is it expected that intelligence and family size will be correlated for one social class group and not for others. A similar picture of independence is assumed for birth order.

Some differences between male and female high school students are expected on some of the aptitude tests because of normative cultural and genetic factors which seem to operate. Socio-cultural differences in certain aptitudes are also expected, though it is doubtful if these occur independently of general intelligence.

In short, the investigator has taken what appears to be the more parsimonious view--that alleged birth order and family size differences in ability are simple artifacts of socio-cultural differences in general intelligence.

The specific hypotheses tested are summarized as follows:

1. Small, negative correlations may be found between intelligence and family size, and between intelligence and birth order, where socio-cultural factors are not specifically controlled.
2. Differences in intelligence are unrelated to family size and birth order indices where socio-cultural factors are controlled.
3. The relationship which intelligence has to indices of family size and birth order is the same for different socio-cultural groups (within the U.S. population).
4. No family size or birth order differences in special aptitudes and skills will be found where differences in general intelligence and in socio-cultural status are controlled.
5. Sex differences independent of general intelligence will be found such that: girls excel boys on language skill and perceptual judgment tasks; and boys excel girls on tasks which require mechanical reasoning and spatial judgment.
6. No socio-cultural differences in special ability will be found which are independent of general intelligence.

Review of the Literature

Evidence that intellectual growth might be related to birth order (BO) or to family size (FS) dates back to Francis Galton's studies of English scientists (1874). He found a disproportionate number of first borns in this special group. Later, Cattell (1917) found more first and last borns than middle borns in his sample of eminent American scientists. Other studies of intellectually gifted students or scientists (Altus, 1965; Bradley, 1969; Nichols, 1968; Roe, 1953; and Terman, 1925) also pointed to higher numbers of first borns.

Few of these studies controlled directly for socio-economic

status or for FS differences which might affect BO frequencies. Bayer (1966) controlled for both socio-economic status and FS level in his national sample of college freshmen and found equal proportions of first and last borns. The proportion of middle borns was slightly lower. Burton (1968) used the same sample with similar controls to compare differences in intelligence. She found a small, statistically significant, decrease in mean IQ with increasing BO levels. But the largest difference, between first and last borns, was equivalent to only 3.3 IQ points.

Most research on FS differences in IQ have used similar narrow age samples which include just one sibling per family. Perhaps the best known of these is the Scottish national survey of 11-year olds (Scottish Council, 1953). The total sample of over 70,000 subjects showed a correlation of -.28 between FS and scores on a group, paper-and-pencil test of intelligence. A representative subgroup tested with the Terman-Merril Stanford-Binet showed a correlation of -.32 with FS. Comparable negative correlations were found for the separate, broadly defined occupational subgroups in this sample. Correlations ranging near -.25 have also been found in several other small scale studies conducted in Europe and America (Anastasi, 1965). Curiously, no BO differences in IQ were found in the Scottish national survey.

A more ideal control for socio-economic differences was employed in the unique study by Thurstone and Jenkins (1929). All siblings from each given family in the sample were tested with the Stanford-Binet. By matching subjects at each BO level for family origin, it was possible to minimise socio-economic differences. Mean IQ's increased continuously with increasing BO levels for families of the same size. For the total sample, FS correlated only -.09 with IQ. These results, based on children referred to a child treatment facility, were duplicated with a more normal population of public school children.

Much of the published research ignores the possibility of interactive effects upon developed intelligence. That is, IQ is assumed to be a simple linear function of FS or of BO. Nisbet (1953), an exception, suggests that the IQ and FS correlation actually increases with age. He found successively higher correlations in his sample of 7, 9, and 11-year olds. But he did not apply strict controls for socio-economic differences. The possibility that IQ scores differ with the age at which subjects are tested has also been demonstrated (Higgins, Reed, and Reed, 1962). This simple artifact, due perhaps to differences in the tests or in the norms for different populations, could explain changes in correlation across some age groups. Moshinsky (1939) found significant correlations between IQ and FS for subjects from middle level occupational groups, but not for subjects from higher and lower occupational groups. This suggests there could be some qualitative differences in parent-child interactions which set off the middle level groups from other levels.

A recent study of 1,430 2nd through 12th graders by the

investigator (McCall and Johnson, in press) found only small, negative correlations of IQ with FS and with BO (-.11 and -.08 respectively) even when socio-economic differences were not controlled. The very heterogeneous sample, in terms of age and cultural background, probably reduced the usual confounding of social class with FS and BO. When controls were applied, statistically, to both age at testing and occupational level, variance in IQ was found to be quite independent of FS and BO level. Also, changes in IQ over a 7 year period for the high school subgroup were unrelated to FS, BO, or to occupational level.

Several investigators have studied BO differences in special aptitude or skill, but FS differences as such have generally been ignored. Perhaps the most widespread claim concerning BO differences (Harris, 1964; Rosenberg and Sutton-Smith, 1964) is the belief that first borns excel in verbal or language skills. This could be due to the greater verbal stimulation (Lasko, 1954) which parents have been observed to provide first borns. Later borns have been assumed to compensate by developing relatively greater perceptual and motor skills. There is little evidence of research which controlled for differences in general intelligence or the qualities of sibling interaction. One exception is the Oberlander and Jenkins study (1967) of BO differences on subtests from the California Achievement Test battery. They used analysis of covariance to control for IQ differences and found no BO differences on the several achievement tests. In their study, a between-family sample design included just one sibling per family.

Most of the BO studies of specific abilities employed a within-family sample design, which compared first borns with their own later born siblings. Koch (1954) matched five and six year olds from 2-child families for socio-economic background and compared both BO and sex differences in performance on the Primary Mental Abilities subtests. Second borns averaged higher Total scores and higher Perceptual test scores. The subjects' sex was also important. Among the first borns, those (either males or females) with a male sibling earned higher Total and higher Verbal scores than those first borns without a male sibling. First born males also excelled first born females on the Verbal test.

At the college level, Rosenberg and Sutton-Smith (1964) found that female students from 2-child families scored higher on the language skill subtest of the American Council on Education test. Also, first born males and females earned higher language than math test scores, individually. Altus (1965) reported similar results for the College Entrance Examination Board tests. Not only did first borns excel second borns on the verbal aptitude test (no difference on the math), those first borns with a male sibling also performed higher on the math aptitude test. In another study with the same tests (Walker and Tahnisian, 1967), it was the female students alone who showed differences. That is, first born and only child females scored higher on both the verbal and the math aptitude subtests.

First borns, especially females, at the junior high school level were found to score higher on several of the Iowa Basic Skill achievement subtests (Chittenden, et. al., 1968). Differences on a test for "creativity" favored first borns and only children in a preschool age sample (Lichtenwalner and Maxwell, 1969). A separate analysis by social class showed that children with middle class backgrounds performed better on the "creativity" test than children from lower classes.

In summary, the findings concerning FS and BO differences in general intelligence are somewhat inconsistent. The main differences seem to be due to the presence or absence of tight controls for socio-cultural differences. Such differences are known to be related to intelligence as well as to family size. And it seems that where socio-cultural factors are rigidly controlled, either by the sample plan or by statistical methods, the correlations between IQ and FS, or BO, prove negligible. Studies of FS and BO differences in special aptitude are also inconsistent, though there is some tendency to find higher verbal skills with first borns. Again, there appears to be insufficient control for the ubiquitous socio-cultural factor. It would seem premature, also, to accept findings as definitive which show that the sex of siblings and their birth orders interact to produce differences in one or another special ability.

We might reasonably expect some differences in special ability to be associated with sex, and perhaps with socio-cultural status. Multi-aptitude test batteries typically show sex differences on specific subtests. For example, on the Differential Aptitude Tests for Spatial Judgment and Mechanical Comprehension, 12th grade males score appreciably higher than females (Bennett, Seashore, and Wesman, 1952). Twelfth grade females, however, score appreciably higher than males on the subtests for language skills and Clerical aptitude. Neither sex showed a practical difference on subtests for verbal and numerical aptitudes. Several of the subtests in the Project Talent battery (including those used in this study) showed sex differences for males and females in a national sample of high school students (Flanagan, et. al., 1964). Most significant were the higher scores for males on the subtests for Mechanical Reasoning and Visualization in Two or in Three Dimensions. Girls scored slightly higher than boys on tests for language skills: English, Word Functions, and Disguised Words. In this particular battery of tests, the sexes performed equally well on tests for Reading Comprehension and Abstract Reasoning. The several Information tests showed definite sex differences consistent with stereotyped sex interests in topics like sports and homemaking.

Socio-cultural differences in general intelligence are well known. But it is difficult to know if there are socio-cultural differences in specific aptitudes which are not due, simply, to intelligence as such. Bernstein (1960) believes that lower and middle class cultures differ in their utilization of language skills.

ERIC

This difference favors the higher development of intelligence in middle class groups. Support for this view is found in evidence that intelligence tests which stress language skills give higher differences between these classes than tests which are non-verbal in nature. We might expect middle class subjects to show relatively higher scores on language skill subtests than on perceptual and motor skill subtests, but it remains to be seen if such differences are completely independent of general intelligence.

Method

All the data for this study came from the Project Talent Data Bank (Schoenfeldt, 1967). This source contains the results from a two-day battery of tests and questionnaires administered in 1960 to the students in a 5 per cent sample of the nation's public, private, and parochial high schools. The resulting sample comprised about 400,000 students in grades 9 through 12. For most of these students there was nearly complete data on the specially devised ability tests and questionnaires. In all, there were 70 distinct part or total scores on the maximum performance tests and many more specific items of information which dealt with interests, future plans, family background, and so on.

Subjects

For present purposes, a random 1 per cent subsample of the total national Project Talent sample was drawn. This produced 3,685 students (49 per cent male; 51 per cent female) for whom there was relatively complete information on the variables chosen for study.

Essentially, the sample comprises just one sibling from any given family. But the national sample plan, which included all of the students in a given school, allowed for some degree of multiple representation from the same family. In this and several other respects, such as socio-cultural background, age, sex, academic skill, and general intelligence, the sample can be reasonably assumed to reflect the makeup of high school students across the nation.

Demographic Variables

The three primary demographic variables used are defined below. In addition <u>sex</u>, <u>age</u>, and <u>grade</u> status were identified for each student.

<u>Family Size (hereafter, FS)</u>-- This index indicates the total number of living children in the student's own family and it is thus equivalent to "sibship" (Anastasi, 1956). Specifically, a code of 1 indicates just one, or an only child; a code of 2 indicates two siblings; and so on to the code of 12, which indicates 12 or more siblings in a given family.

Birth Order (hereafter, BO)-- This second index, calculated for each student, represents his rank position in terms of order of birth within his family. Thus, a code of 1 indicates a student who is the first born child, perhaps the only child in his particular family. Codes of 2 indicate second borns and so on.

Socio-economic Status (hereafter, SES)-- This special index was derived by Project Talent personnel (Flanagan and Cooley, 1966; see Appendix E) so that each student could be located on a dimension which represents socio-economic environment. A weighted average of the standard scores for each student's responses to nine different items was adjusted to provide a mean of 100 and standard deviation of 10 for the males in grade 12. The information items concerned: value of home, family income, father's occupation, father and mother's education, own room for study, and number of books, appliances and televisions in the home.

These authors report that there are no sex differences in mean SES scores within grade levels and the means decrease slightly from grade 12 to grade 9. This decline is consistent with expected high school dropout rates.

For some of the statistical calculations in this study, the original SES scores were coded to represent quintile score equivalents. Scores of 58-92 were coded 1; 93-97 were coded 2; 98-102 coded 3; 103-107 coded 4; and 108-135 coded 5. These five intervals were defined so as to produce an equal number of observations at each quintile level in a theoretically normal distribution of SES scores.

Ability Variables

Among the 70 different total or part scores available in the Project Talent Data Bank for each student, only the "Composite IQ" and a selected number of special ability scores were chosen for study. The latter tests (listed below) were arbitrarily selected to represent a wide range of special aptitudes and developed proficiencies. It was assumed that some of these variables would also vary with sex groups and with socio-economic status.

Composite IQ-- This measure of general intelligence was derived internally by the Project Talent staff from three different tests-- which were designed to assess reading comprehension, abstract reasoning, and mathematical aptitude. These three skill functions were weighted 51 per cent, 25 per cent, and 24 per cent, respectively (Flanagan, et. al., 1964). This IQ-composite scale differs from conventional IQ scales because the scores range up to 280, with a mean near 170.

The reading tests comprised two separate sets of 100 multiple-choice items dealing with comprehension of fiction and non-fiction passages. The test for abstract reasoning consisted of nonverbal problems of conceiving relationships among diagrams and extrapo-

lating them. The third component, arithmetic reasoning, included 16 items which assessed knowledge of how to solve elementary math problems without actually doing computations.

Special Abilities-- In addition to the IQ-composite score, eight separate special ability scores were obtained for each student. These were arbitrarily selected from the entire set of 70 total and part scores which were collected for the national high school sample. Their choice was made on the basis of variety and the possibility that sex and social class differences might occur. Also, it seemed appropriate to exclude the particular subtests which were used to derive Composite IQ.

There follows a brief description of the special ability scores (Flanagan and others, 1965):

Vocabulary- This test comprises two subtests from the Information Subtests, Parts I and II. It was designed to measure the relative size of a student's general vocabulary. This same ability is sometimes called "verbal intelligence".

English, Total- Five different subtest results are contained in this total score. These are: spelling, capitalization, punctuation, English usage, and effective expression. These are assumed to measure ability to express oneself adequately in English, primarily in its written form.

Creativity- This test seeks to measure the ability to find ingenious solutions to a variety of practical problems. High scores are interpreted to reflect inventiveness or creative ingenuity.

Mechanical Reasoning- Ability to visualize the operations of everyday physical forces is required for this test. While past training or experience should be considered, the test results are fairly independent of specific training in crafts.

Visualization in Two Dimensions- This test measures the ability to visualize how diagrams would look after being turned around on a flat surface, in contrast with the way they would look after being turned over.

Arithmetic Computation- Speed and accuracy in performing the basic computational operations of addition, subtraction, multiplication, and division of whole numbers is required for this test. These skills are considered important in high school and college mathematics.

Clerical Checking- Speed and accuracy of perception in a very simple task is required. This task involves comparing each pair of names in a series to determine if they are identical.

Object Inspection- This test measures speed and accuracy in form

perception. Minor differences in small objects must be quickly and accurately detected.

The Multiple Regression Method

A special multiple regression procedure (Kelly, Beggs, McNeil, Eichelberger, & Lyon, 1969) was employed in addition to the familiar descriptive and correlation methods. Its main purpose was to test hypotheses concerning the independent and combined effects upon IQ of FS, BO, and SES. A brief explanation of its rationale is in order.

The multiple regression method requires the investigator to first construct special models by which a chosen criterion variable is correlated with one or more predictor variables. The resulting correlation, between the criterion and its best estimate (based on the correlations with predictors), is termed R^2. This statistic is also said to indicate the proportion of criterion variance which is "explained" by the predictor variables.

Once two or more predictor models have been constructed, their relative success in prediction (i.e., in accounting for criterion variance) may be formally compared by the *F*-test. For example, if one model included FS and SES as predictors of IQ, and a second model used only SES to predict IQ, then the *F*-test could be used to test whether the difference in resulting R^2s was within the range of chance expectation. In other words, did FS contribute anything to the prediction of IQ that SES did not do alone?

The procedure is highly flexible in that special vectors may be derived (Kelly, et. al., 1969) which represent different ways of combining variables. Thus, it was possible to test for departures from linearity and for interaction effects, with and without specified covariate controls. The multiple regression procedure thus closely parallels the analysis of variance procedure in several respects. It has, however, the advantage of not requiring equal observations at each level of classification.

One disadvantage with using any statistical test for chance deviations with large samples is the likelihood that small, impractical differences prove to be "significant". For example, R^2 differences as small as .01 are significant for samples of 3,000 and more in most *F*-test comparisons. In the present study, R^2 differences of less than .05 were considered negligible because they were assumed to lack either theoretical or practical importance.

Results

The number of males and females at each school grade level and at each FS level for the total sample are reported in Tables 1 and 2. Percentages are reported for both the 1% subsample used in this

Table 1

Total Sample Frequencies And Percentages By Grade And Sex, Compared With Project Talent Results[1]

	9th Grade			10th Grade			11th Grade			12th Grade			Total Sample	
Sex	n	% total	% sex	n	% total	% sex	n	% total	% sex	n	% total	% sex	n	% total
M	473	12.8	26.2 (27.7)	478	13.0	26.5 (26.9)	444	12.0	24.6 (24.2)	410	11.1	22.7 (21.0)	1805	49.0 (48.9)
F	526	14.3	28.0 (27.3)	502	13.6	26.7 (26.3)	463	12.6	24.6 (24.4)	389	10.6	20.7 (21.8)	1880	51.0 (51.0)
Total	999	27.1 (27.5)		980	26.2 (26.6)		907	24.6 (24.3)		799	21.7 (21.4)		3685	100

[1]Figures in parentheses refer to the national sample, A-100 (Flanagan, et. al., 1964)

Table 2

Total Sample Frequencies By Family Size And Sex, Compared With Project Talent Results[1]

	Family Size: 1			2			3			4			5			6-up		
Sex	n	% total	% sex	n	% total	% sex	n	% total	% sex	n	% total	% sex	n	% total	% sex	n	% total	% sex
M	353	9.6	19.6 (10.3)	365	9.9	20.2 (24.9)	335	9.1	18.6 (22.8)	280	7.6	15.5 (15.5)	183	5.0	10.1 (9.9)	289	7.8	16.0 (16.2)
F	281	7.6	15.0 (9.6)	407	11.0	21.6 (25.0)	379	10.3	20.2 (22.0)	291	7.9	15.5 (16.2)	181	4.9	9.6 (10.0)	341	9.2	18.1 (17.2)
	634	17.2		772	21.0		714	19.4		571	15.5		364	9.9		630	17.1	

[1]Figures in parentheses refer to the national sample (Flanagan, et. al., 1964)

study and the national Project Talent sample of about 400,000 subjects. Tables 1 and 2 show that almost equal percentages of males and females occur at the different grade and FS levels. The fact that almost identical percentages occur for the local and the national samples testifies to the success of the random selection method. This conclusion is supported by the comparable ability score results for the local and national samples. In some of the analyses which follow, subjects with missing data relative to the critical variables under study were omitted. The shrinkage to 3, 126 subjects still left a sample with nearly identical distributions on the demographic and ability variables.

Table 3 summarizes the means and standard deviations observed for the major demographic variables and the IQ-composite score. This table also includes the intercorrelations computed for these same variables.

Table 3

Means, Standard Deviations, and Pearson Correlations For The Demographic Variables and For IQ-composite Scores (N = 3,308)

			r			
Variables	$\bar{X}$	S	FS	BO	SES	IQ
Grade	10.42	1.09	-.05	-.08	.08	.28
Family Size	3.83	2.27		.55	-.26	-.22
Birth Order	2.49	2.21			-.17	-.26
Socioec. Status	97.89	10.11				.42
IQ-composite	165.57	54.12				

As expected, IQ correlates negatively (i.e., -.22 and -.26) with both FS and BO, where no direct control for SES is imposed.

The fact that SES correlates .42 with IQ, -.26 with FS, and -.17 with BO suggests that the correlations of IQ with FS and with BO are spurious. The partial correlation method was used to control for SES, with the following results: IQ correlated -.13 with FS and -.21 with BO when SES was controlled. The IQ correlation with FS became -.02 when both SES and BO were controlled by the partial correlation method. The IQ correlation with BO became -.17 when both SES and FS were controlled. It is assumed that a control for grade level differences in BO and in IQ would further reduce the correlation of IQ with BO.

The multiple regression procedure was used to control for IQ differences in SES while evaluating IQ differences in FS and in BO groups. The results are given in Table 4. The left portion of Table 4 shows, in terms of R^2, the proportion of IQ variance accounted for by the control predictor variables. To the right are shown the specific gains in R^2 achieved by adding a specific predictor to the one or more control predictors. Clearly, the only important gains to the prediction of

IQ (i.e., increase in proportion of variance explained) are obtained when SES is added to the predictor models. Specifically, 15 and 14 per cent gains are achieved by adding SES to FS and to BO, respectively. The independent contribution of SES is somewhat better reflected in the gain of 13 per cent (R^2 gain is = 128) when SES is added to the combined FS and BO predictors.

Table 4

Tests for the Independent Effects Upon IQ Variance Due To Family Size (FS), Birth Order (BO), and Socio-economic Status (SES) (N = 3,308)

Control Predictor	R^2 Controls	Gain In R^2 By Adding A Predictor: FS	BO	SES	Only Child	First Born
FS	.044			.151		
BO	.068			.143		
FS, BO	.084			.128		
SES	.175	.020	.026			
FS, SES	.195		.018			.005
BO, SES	.201	.006			.013	

The independent contributions of FS and BO are indicated most accurately where each is added to the control predictor models. Thus, where FS is added to SES, the gain is only 2 per cent. And when BO is included with SES as covariate controls, the contribution of FS to IQ variance is only about 1 per cent (R^2 gain is .006). For BO, the gain over SES is about 3 per cent and over the combined FS and SES controls, the gain is 2 per cent. By accepting 5 per cent as a practical gain criterion, we may conclude that neither FS nor BO adds independently to the prediction of IQ.

From Table 4 we also see that no increase in prediction is achieved by replacing FS with the "Only Child" variable and by replacing BO with the "First Born" variable. To explain, special predictor vectors were generated which indicated whether each subject was an "only child" or not, and whether each subject was a "first born" or not. Actually, the previous tests for linearity, between IQ and FS or BO, indicated the relationships were essentially linear. This ruled out the chances of showing that any single FS or BO level would be more predictive of IQ.

Table 5 reports the results of statistical tests for interaction effects upon IQ. The multiple regression procedure was used, which tests for interaction by comparing the R^2s generated when the same predictors are defined as independent and as interactive vectors.

We see from Table 5 that none of the interactive vectors increases R^2 beyond that achieved by the independent, joint predictors. In more clear terms, neither FS nor BO interacts significantly with SES to affect IQ variance. FS and BO do not interact with each other also, where their correlations with SES is controlled.

The next portion of the study concerns possible FS, BO, SES, and sex differences for each of the eight different special abilities. Separate means and standard deviations were computed for each of the ability measures for males, females, and for each FS, BO, and SES group. These findings are shown in the appendices A through D.

Table 5

Tests For The Interaction Effects Upon IQ Variance Due To Family Size (FS), Birth Order (BO), and Socio-economic Status (SES) (N = 3,308)

Predictor Models	R^2	Model Contrasts	R^2 - Difference
1. FS, BO, SES	.212		
2. FS, BO, (FS·SES)	.213	1 vs 2	.001
3. FS, BO, (BO·SES)	.218	1 vs 3	.006
4. BO, SES (BO·FS)	.206	1 vs 4	-.006

Table 6 reports the total sample means and standard deviations for each of these eight abilities. It also shows their intercorrelations with IQ and with the several demographic variables.

Table 6

Means, Standard Deviations, And Frequencies For Selected Ability Variables--Plus Pearson Correlations With Sex, Family Size (FS), Birth Order (B), Socio-economic Status (SES), And IQ

Ability Variable	n	$\bar{X}$	Sd	r: Sex[1]	FS	BO	SES	IQ
Vocabulary	3530	17.58	5.99	-.03	-.22	-.22	.40	.76
English	3603	80.69	13.84	.24	-.16	-.19	.32	.73
Creativity	3577	8.62	3.94	-.10	-.18	-.19	.31	.62
Mech. Rea.	3583	10.35	4.31	-.46	-.14	-.14	.27	.52
Visualization	3551	12.71	5.65	-.18	-.09	-.08	.19	.38
Arith. Comput.	3598	37.75	10.53	.11	-.09	-.10	.25	.50
Cler. Check.	3591	37.54	14.67	.11	.00	.00	.07	.06
Obj. Inspect.	3586	23.15	7.15	.04	-.07	.04	.13	.17

[1]Males are coded 1; females coded 2.

These intercorrelations, themselves, suggest there are important sex differences in English (favoring females) and in Mechanical Reasoning and Visualization of Space Relations (both favoring males). Several variables correlate slightly with FS and with BO. But these same variables also correlated higher with SES and with IQ. The highest correlations are between IQ and Vocabulary or English, which

indicates the importance of verbal skills for the underlying intelligence subtests (Reading, Abstract Reasoning, and Mathematics). And the closely parallel changes in correlation as one moves from the more to the less verbal skill tests raises the suspicion that a verbal skill factor underlies most of the correlations, except for those with sex.

The results of testing for the independent contributions of FS, BO, SES, and sex--while controlling for IQ, are reported in Table 7. In some of the tests, sex or SES was included with IQ as a covariate control. A study of the individual R^2s, plus the gains from adding either sex, FS, BO, or SES to the predictor model, shows that IQ is almost the only source of variance in special aptitude. Specifically, neither FS, BO, nor SES accounts for variance in these aptitudes above that associated with IQ. The important exceptions concern sex, which predicts differences in English and in Mechanical Comprehension with IQ and SES held constant. The slight sex differences (i.e., proportions of variance explained by sex in Visualization, Arithmetic Computation, and in Clerical Checking are barely greater than chance, but the gain in predictability over IQ is less than the practical criterion of .05.

<u>Summary</u>

These findings may be usefully summarized in relation to the specific hypotheses which guided the design of the study:

1. The hypothesis was confirmed that IQ would be correlated to a small extent (negatively) with FS and with BO, where SES differences in IQ were not controlled. These correlations seem to be due to the confounding of SES with the other variables.
2. The hypothesis was confirmed that adequate statistical controls for SES would remove the apparent correlations of IQ with FS and BO. Of course, only minor reductions in the *r*'s resulted from the partial correlation method. But the multiple regression procedure, which proved more effective, is considered more appropriate.
3. The hypothesis was confirmed that neither FS nor BO interacts with SES to influence IQ. This more general statement includes the specific tests for differences in IQ which might be associated with status as first borns or only children.
4. As was hypothesized, no FS or BO differences in special ability were found after differences due to IQ (and to SES) were removed. Without controls for IQ and for SES, there were FS and BO differences in Vocabulary, English, Creativity, and Mechanical Reasoning. But these differences seem to be explained by underlying differences in IQ.
5. The hypothesized sex differences in special ability, independent of IQ, were partly confirmed. The girls excelled boys on the test for writing skills in English and the boys performed better on the Mechanical Reasoning test. But the control for IQ largely removed sex differences in spatial

Table 7

Tests For Independent Contributions To Variance In Selected Ability Variables of Sex, Family Size (FS), Birth Order (BO), and Socio-economic Status (SES)-- With Controls For IQ, SES, or Sex (N = 3,126)

Ability Variable	Control Predictors	R^2 Controls	Gain In R^2 By Adding A Predictor: Sex	FS	BO	SES
Vocabulary	IQ	.668	.008	.005	.002	.011
	IQ, Sex	.676				.011
	IQ, SES	.679	.008	.002	.002	
English	IQ	.582	.065	.000	.001	.001
	IQ, Sex	.648				.001
	IQ, SES	.583	.066	.000	.001	
Creativity	IQ	.413	.011	.003	.002	.005
	IQ, Sex	.425				.005
	IQ, SES	.418		.002	.002	.011
Mechanical Compreh.	IQ	.303	.217	.001	.000	.003
	IQ, Sex	.520				.002
	IQ, SES	.3065	.215	.000	.000	
Visualization in 2 Dimen.	IQ	.156	.033	.000	.000	.003
	IQ, Sex	.191				.002
	IQ, SES	.159	.032	.000	.000	
Arithmetic Computation	IQ	.248	.013	.000	.000	.003
	IQ, Sex	.261				.003
	IQ, SES	.251	.014	.000	.000	
Clerical Checking	IQ	.004	.014	.000	.000	.006
	IQ, Sex	.018				.003
	IQ, SES	.006	.014	.000	.000	
Object Checking	IQ	.023	.002	.002	.000	.005
	IQ, Sex	.025				.005
	IQ, SES	.028	.002	.001	.000	

judgment (Visualization) and in perceptual judgment (Clerical Checking and Object Inspection).

6. As predicted, no socio-cultural differences independent of general intelligence were found in the several aptitudes considered.

Conclusions and Recommendations

These findings generally discount the theory of intellectual primogeniture, or the belief that first borns and only children are especially favored for intellectual growth. Special theories concerning possible FS or BO differences in narrowly specified aptitudes or skills are also discounted. Of course, these conclusions are limited to the type of aptitudes represented in the eight different skill tests which were studied. It should be noted that these same skills (English, vocabulary, arithmetic, mechanical reasoning, spatial judgment, and clerical ability) are contained in several of the standardized multi-aptitude batteries which are used with high school students.

It seems reasonable, from these findings, to conclude that no special educational remedies need to be planned for children who are classed as "later borns". And while there are several excellent reasons for practicing birth control, the claim that later borns are necessarily handicapped intellectually appears to be invalid.

The results of this study demonstrate that there are important intellectual differences associated with the members of different socio-economic groups within the American high school. These differences, which primarily concern language or verbal skills, are well known and they deserve our constant attention. Of course, remedial education programs for these skills must begin at a much earlier age (even pre-school!) if they are to affect developed intelligence.

The significant sex differences in English language skills and Mechanical Reasoning support the existance of specialized vocational courses for boys and girls at the high school level. Since there remain large differences in aptitude within each sex group, individual guidance of boys and girls should be retained as a general policy. More research is needed to separate the purely biological and cultural origins of these sex differences in ability.

References

Altus, William D. Birth order and academic primogeniture. Journal of Personality and Social Psychology, 1965, 32, No. 6, 872-876.

Anastasi, Anne Intelligence and family size. Psychological Bulletin, 1956, 53, No. 3, 197-209.

Bayer, A. E. Birth order and college attendance. Journal of Marriage and Family Living, 1966, 28, 480-484.

Bennett, G. K., Seashore, H. G., and Wesman, A. G. A Manual For The Differential Aptitude Tests. New York: The Psychological Corporation, 1952.

Bernstein, Basil Language and social class. British Journal of Sociology, 1960, 11, 271-276.

Bradley, Richard W., & Sanborn, Marshall P. Ordinal position of high school students identified by their teachers as superior. Journal of Educational Psychology, 1969, 60, 41-45.

Burton, Dee Birth order and intelligence. Journal of Social Psychology, 1968, 76, 199-206.

Cattell, J. M. Families of American men of science. Scientific Monthly, 1917, 5, 368-377.

Chittenden, E. A., Foam, M. W., Zweil, D. M., & Smith, J. R. School achievement of first- and second-born siblings. Child Development, 1968, 39, 1223-1228.

Flanagan, J. C., & Cooley, W. W. Project Talent, One-Year Follow-Up Studies. Pittsburgh, Pa.: University of Pittsburgh, 1966.

Flanagan, John C., Cooley, W. W., Shaycoft, M. F. and others. The Project Talent Data Bank, Pittsburgh, Project Talent, 1965.

Flanagan, J. C., Davis, F. B., Dailey, J. T., Shaycroft, Marion F., Orr, D. B., Goldberg, I., & Neyman, C. A., Jr. The American High-School Student, Washington, D. C.: University of Pittsburgh, Project Talent Office, 1964.

Galton, F. English Men of Science: Their Nature And Nurture. London: MacMillan, 1874.

Harris, I. D. The promised seed: A comparative study of eminent first and later sons. Glencoe, Ill.: Free Press, 1964.

Higgins, J. V., Reed, Elizabeth W., & Reed, S. C. Intelligence and family size: a paradox resolved. Eugenics Quarterly, 1962, 9, 84-90.

Kelly, F. J., Beggs, D. L. & McNeil, K. A., with Eichelberger, T., & Lyon, J. Multiple Regression Approach: Research Design In The Behavioral Sciences. Carbondale-Edwardsville: Southern Illinois University Press, 1969.

Koch, Helen L. The relation of primary mental abilities in five- and six-year olds to sex of child and characteristics of his sibling. Child Development, 1954, 25, 209-223.

Lasko, J. K. Parent behavior toward first and second children. Genetic Psychology Monograph, 1954, 49, 97-137.

Lichtenwalner, J. S., & Maxwell, J. W. The relationship of b.o. and s.e.s. to the creativity of preschool children. Child Development, 1969, 40, 1241-1247.

McCall, John N., & Johnson, Orval G. The independence of intelligence from family size and birth order. Journal of Genetic Psychology, in press.

Moshinsky, Pearl The correlation between fertility and intelligence within social classes. Sociological Review, 1939, 31, 144-165.

Nichols, Robert C. Heredity, environment, and school achievement. Measurement and Evaluation in Guidance, 1968, 1, 122-129.

Nisbet, J. D. Family Environment: A Direct Effect of Family Size on Intelligence. Occasional Paper on Eugenics, No. 8. Eugenics Society and Cassell, 1953.

Oberlander, M., Jenkin, N., Houlihan, K., & Jackson, J. FS and BO as determinants of scholastic aptitude and achievement in a sample of eighth graders. Journal of Consulting and Clinical Psychology, 1970, 34, 19-21.

Roe, Anne The Making of A Scientist. New York: Dodd, Mead, 1953.

Rosenberg, B. G., & Sutton-Smith, B. The relationship of ordinal position and sibling sex status to cognitive abilities. *Psychonomic Science*, 1964, *1*, 81-82.

Schoenfeldt, Lyle F. The Project Talent Data Bank, *Social Science Information*, 1967, 6, 161-173.

Scottish Council for Research in Education. *Social Implications of the 1947 Scottish Mental Survey*. London: University of London Press, 1953.

Terman, L. M. Genetic Studies of Genius. V. 1, *The Mental and Physical Traits of a Thousand Gifted Children*. Stanford: Stanford University Press, 1925.

Thurstone, L. L., & Jenkins, R. L. Birth order and intelligence. *Journal of Educational Psychology*, 1929, *20*, 641-651.

Walker, C. E., & Tahnisian, J. Birth order and student characteristics: a replication. *Journal of Consulting Psychology*, 1967, *31*, 219.

Appendix A

Means, Standard Deviations, And Frequencies For Each Family Size Group In IQ-composite And Eight Special Abilities

Family Size		IQ-Comp.	Vocabulary	English	Creativity	Mechl. Reas.	Visual. 2 dim.	Arithm. Comp.	Cler. Check.	Object Insp.
1	n	305	296	303	301	303	302	304	303	302
	$\bar{X}$	168.54	18.70	81.93	9.24	10.78	13.22	37.77	37.98	24.39
	S	55.41	5.83	13.70	3.89	4.24	5.59	10.82	14.14	7.00
2	n	757	748	757	754	755	754	756	757	755
	$\bar{X}$	179.53	19.46	84.14	9.55	11.09	13.31	39.61	37.77	23.90
	S	51.49	5.68	12.32	3.95	4.36	5.47	9.94	14.09	6.84
3	n	704	693	701	703	704	694	701	703	705
	$\bar{X}$	173.85	18.59	82.69	9.03	10.64	13.09	39.01	38.18	23.38
	S	51.22	5.67	12.71	3.80	4.30	5.51	10.10	14.55	7.17
4	n	564	556	564	561	562	554	563	562	562
	$\bar{X}$	164.66	17.65	80.97	8.66	10.62	12.68	38.52	37.06	23.27
	S	52.13	5.60	13.39	3.94	4.34	5.68	9.85	14.40	7.15
5	n	355	359	355	352	353	352	355	353	353
	$\bar{X}$	162.37	17.08	80.93	8.47	9.99	12.68	38.47	37.12	22.24
	S	52.33	5.67	12.54	3.83	4.39	5.60	10.19	14.51	6.80
6-up	n	618	603	619	609	617	603	618	614	615
	$\bar{X}$	141.55	14.86	76.43	7.19	9.02	11.56	35.56	38.37	22.56
	S	52.92	5.71	14.21	3.63	4.05	5.92	10.63	15.86	7.40

Appendix B

Means, Standard Deviations, And Frequencies For Each Birth Order Group In IQ-composite And Eight Special Abilities

Birth Order		IQ-Comp.	Vocabu-lary	English	Creati-vity	Mechl. Reas.	Visual. 2 dim.	Arithm. Comp.	Cler. Check.	Object Insp.
1	n	1598	1558	1608	1596	1596	1585	1605	1601	1595
	$\bar{X}$	170.34	18.43	81.60	9.04	10.70	12.96	37.70	37.12	23.79
	S	54.83	6.19	14.12	4.01	4.33	5.55	10.82	14.28	7.12
2	n	914	896	912	909	911	903	911	912	911
	$\bar{X}$	170.41	18.08	82.60	9.05	10.70	13.13	39.09	38.56	23.79
	S	50.83	5.55	12.23	3.87	4.36	5.72	9.94	14.96	6.91
3	n	427	422	427	424	426	421	427	426	426
	$\bar{X}$	162.80	17.54	80.96	8.39	10.18	12.51	38.71	37.99	23.08
	S	51.53	5.32	12.66	3.73	4.07	5.51	10.27	14.80	7.28
4	n	256	255	255	252	256	251	255	256	256
	$\bar{X}$	153.64	16.09	78.74	7.86	9.62	11.76	36.22	36.30	21.93
	S	50.22	5.59	12.32	3.81	4.24	5.54	9.39	14.65	6.56
5	n	149	151	149	148	148	148	148	149	149
	$\bar{X}$	148.68	15.52	76.75	7.55	9.22	11.97	37.22	37.99	22.74
	S	53.90	5.63	15.75	3.56	4.21	5.82	11.14	14.98	7.49
6-up	n	251	248	252	248	248	245	252	247	249
	$\bar{X}$	123.50	13.33	71.87	6.17	8.58	11.36	33.41	36.83	21.96
	S	52.54	5.60	15.79	3.33	3.94	6.00	10.55	15.63	8.06

Appendix C

Means, Standard Deviations, And Frequencies For Each Socio-economic Status Group In IQ-composite And Eight Special Abilities

SES		IQ-Comp.	Vocabulary	English	Creativity	Mechl. Reas.	Visual. 2 dim.	Arithm. Comp.	Cler. Check.	Object Insp.
1	n	1199	1169	1208	1189	1191	1178	1206	1199	1195
	X	140.04	14.83	75.44	7.26	9.09	11.49	34.52	36.26	21.87
	S	51.87	5.58	13.91	3.64	4.09	5.65	10.91	15.02	7.37
2	n	627	626	628	620	626	621	627	625	624
	X	159.91	17.02	79.71	8.36	9.98	12.51	37.61	37.36	23.48
	S	52.98	5.86	14.51	3.76	4.23	5.51	10.93	15.14	7.24
3	n	646	634	645	645	645	640	643	643	644
	X	171.75	18.47	83.15	9.13	10.69	13.09	38.74	37.55	23.44
	S	48.84	5.23	11.74	3.79	4.20	5.54	9.38	14.02	6.70
4	n	524	519	523	526	526	520	523	526	526
	X	180.48	19.23	84.13	9.40	11.27	13.56	39.92	38.53	23.78
	S	48.35	5.50	12.73	3.82	4.28	5.51	9.06	14.09	6.89
5	n	599	582	599	597	597	594	599	598	597
	X	194.11	21.27	86.67	10.36	12.09	14.21	41.42	39.47	24.51
	S	49.55	5.38	12.00	4.03	4.17	5.54	9.80	14.43	6.93

Appendix D

Means, Standard Deviations, And Frequencies For Males And Females In IQ-composite And Eight Special Abilities

Sex		IQ-Comp.	Vocabulary	English	Creativity	Mechl. Reas.	Visual. 2 dim.	Arithm. Comp.	Cler. Check.	Object Insp.
Male:	$\underline{n}$	1764	1720	1763	1757	1758	1749	1762	1764	1760
	$\bar{X}$	164.54	18.08	77.31	9.01	12.41	13.74	36.55	35.84	22.88
	S	55.93	6.11	14.35	4.17	4.14	5.69	10.45	14.59	7.71
Female:	$\underline{n}$	1831	1810	1840	1820	1827	1804	1836	1827	1826
	$\bar{X}$	163.68	17.11	83.94	8.25	8.37	11.72	38.89	39.20	23.41
	S	52.85	5.83	12.52	3.67	3.46	5.44	10.48	14.57	6.56

ERIC Full Text Provided by ERIC